As the results indicate, the contact stresses measured for the control liners were higher than those measured for WIAM-treated liners. Based on the contact stress values obtained from the other WIAM liners, it is believed that the contact stress in WIAM liners with 26 mm inner diameter and 49 mm outer diameter will be between 17 and 26 MPa. As discussed above, contact stress can be reduced by decreasing the modulus of elasticity.

Still further embodiments are within the following claims.

What is claimed is:

1. A hip joint prosthesis comprising a load bearing portion and a mating portion that define a cavity and a head articulated to provide motion such that θ_{max} is about 60° or more, wherein at least one of the bearing portion and the mating portion comprises radiation treated ultra high molecular weight polyethylene polymer having substantially no detectable free radicals, wherein the head cross-section is greater than about 35 mm, and where the thickness of said polymer is about 1 mm to about 5 mm.

2. The prosthesis of claim 1 wherein θ_{max} is about 60° to about 90°.

3. The prosthesis of claim 1 wherein θ_{max} is about 60° to about 70°.

4. The prosthesis of claim 1 wherein the head cross-section is between about 35 mm and about 40 mm.

5. The prosthesis of claim 1 wherein the head cross-section is about 40 mm to about 70 mm.

6. A hip joint prosthesis comprising a load bearing portion and a mating portion that define a cavity and a head articulated to provide motion, wherein at least one of the bearing portion and the mating portion comprises radiation treated ultra high molecular weight polyethylene polymer having substantially no detectable free radicals and wherein the head cross-section is between about 20 mm to about 35 mm and the thickness of said polymer is about 1 mm to about 5 mm.

7. The prosthesis of claim 1 or claim 6 wherein the thickness of the polymer is greater than about 2 mm to about 4 mm.

8. The prosthesis of claim 1 or claim 6 wherein the thickness is about 3 mm.

9. The prosthesis of claim 1 or claim 6 wherein the thickness is about 1 mm to about 2 mm.

10. The prosthesis of claim 1 or claim 6 wherein the bearing portion has a rim chamfer, wherein the chamfer angle θ_c is substantially equal to θ_{max}.

11. The prosthesis of claim 1 or claim 6 wherein the polymer has a storage modulus of about 850 MPa or less.

12. The prosthesis of claim 1 or claim 6 wherein the contact stress is less than about 10 MPa.

13. The prosthesis of claim 1 or claim 6 wherein the cavity depth is about 16 mm or more.

14. The prosthesis of claim 1 or claim 6 wherein the bearing portion defines a sphere segment cavity and said mating portion is a ball head.

15. The prosthesis of claim 14 wherein the sphere segment is a hemisphere.

16. The prosthesis of claim 14 wherein the sphere segment defines less than a hemisphere in all directions of motion.

17. The prosthesis of claim 14 wherein the sphere segment defines less than a hemisphere in a selected direction of motion and a hemisphere in another direction of motion.

18. The prosthesis of claim 14 wherein the bearing portion comprises said polymer and the mating portion comprises metal or ceramic.

19. The prosthesis of claim 14 wherein the mating portion comprises a prosthetic ball member attached to the femur.

20. The prosthesis of claim 14 wherein the mating portion comprises a shell covering an existing femoral ball.

21. A hip joint prosthesis comprising a load bearing portion and a mating portion that defines a cavity and a head articulated to provide motion, wherein at least one of the bearing portion and the mating portion comprises radiation treated ultra high molecular weight polyethylene having substantially no detectable free radicals and the thickness of the polymer is about 1 mm to about 2 mm.

22. The prosthesis of claim 21 wherein the head cross-section is about 40 mm to about 70 mm.

23. The prosthesis of claim 21 wherein the head cross-section is about 20 mm to about 35 mm.

24. A hip joint prosthesis comprising a load bearing portion and a mating portion that define a cavity and a head articulated to provide motion, wherein at

least one of the bearing portion and the mating portion comprises radiation treated ultra high molecular weight polyethylene polymer having substantially no detectable free radicals and wherein the head cross-section is greater than about 35 mm.

25. The prosthesis of claim 24 wherein the head size is about 35 mm to about 70 mm.

26. A hip joint prosthesis system comprising:

(a) a load bearing portion and a mating portion that define a cavity and a head articulated to provide motion wherein at least one of said bearing portion and mating portion comprises radiation treated ultra high molecular weight polyethylene; and

(b) an attachment system for attaching said bearing portion to a patient, said attachment system comprising bone cement, a metal shell, or a combination of bone cement and metal shell,

wherein the head cross-section (HS) satisfies:

$HS = SS - 2T_C - 2T_s - 2T_L$

where

SS is pelvic socket size,

T_C is bone cement thickness, which is 0 to about 6 mm,

T_s is shell thickness, which is 0 to about 5 mm,

T_L is polymer thickness which is about 1 mm to about 5 mm, and

when HS is greater than about 35 mm, θ_{max} is about 60° or greater.

27. The system of claim 26 wherein HS is about 28 mm or more when SS is about 44 mm or less.

28. The system of claim 26 wherein HS is about 32 mm or more when SS is about 43 mm or more.

29. The system of claim 26 wherein HS is about 45 mm or more when SS is about 55 mm or more.

30. The system of claim 26 wherein T_C is about 3 mm.

31. The system of claim 26 wherein T_S is about 3.5 mm.

32. The method of claim 26 wherein T_L is about 3 to about 4 mm.

33. The method of claim 26 wherein T_L is about 3 mm.

34. The method of claim 26 wherein T_L is about 1 to about 2 mm.

35. A kit comprising a prosthesis system described in claim 26.

36. A method of implanting a hip joint prosthesis, comprising determining socket size, and implanting a prosthesis described in claim 26.